Tetra Tech - Cost and Engineering Analysis of Cooling System Retrofits
PG&E Response to Tetra Tech's January 2008 Comments

PALO VERDE AND HOPE CREEK ARE SUBSTANTIALLY DIFFERENT FROM THE PROPSOSED RETROFIT AT DIABLO

It is incorrect to classify the Palo Verde Nuclear Station as a "salt water make-up mechanical draft" facility. The cooling water make-up at the facility is more appropriately designated "hard water with salinity" and is not equivalent to ocean saltwater. PG&E agrees that total dissolved solids in the power plant's cooling water supply results in an overall metal-salts concentration similar to seawater, however, the chemical composition of the water is not similar. The salt in seawater is primarily Sodium Chloride (NaCL), where as the dissolved salts in the water supply at Palo Verde is not. Palo Verde make-up water is contaminated with a variety of chemicals primarily Calcium Carbonate ($CaCO3$) and other non-chloride constituents.

There is a distinct difference in this chemistry. Chloride contamination of the secondary system (turbine steam and condensate closed cycle system) is a significant concern for Pressurized Water Reactor (PWR) facilities. Chlorides result in excessive degradation of secondary system stream generator metals. Even transient elevated chlorides in the secondary system can require shut down of an operating PWR unit. Chloride contaminate excursions have resulted in shutdown of DCPP units previously, and ongoing chemistry management challenges posed by even minor in-leakage exhibited with the existing condensers (at current operating pressures) result in significant ongoing costs to the facility. With elevated sodium chloride concentrations in the proposed mechanical draft closed-cycle system (minimum 1.5X raw seawater), and condenser inlet operating pressures of approximately 45-50 PSI (verse current normal range of 5.5 to 9.5 PSI), chloride contamination of secondary condensate would be more difficult to control, and any leak much more significant to plant operability. At a minimum, it supports the contention that a complete replacement of the existing main steam condensers would be a requirement of a retrofit. It would be imperative that condenser tubes and tube sheet junctions capable of withstanding the higher pressures, as well as an installation that can realistically be operated with continuous leak-tight performance, would be necessary. Extensive upgrade or complete replacement of the existing turbine building main steam condenser to facilitate a closed-cycle retrofit would be required for this reason alone.

The Hope Creek facility is also not an appropriate comparison to the proposed retrofit of DCPP. Make-up water at this location is actually brackish (variable freshwater/seawater mixture) and not equivalent to ocean saltwater. Sodium Chloride concentrations in the Delaware River Estuary location range between 0 and 20,000 ppm dependent on tidal flux and freshwater river flow volume. The plants cooling tower loop routinely operates between 13,000 and 18,000 ppm Sodium Chloride with 1.3x concentration of make-up water contaminates. Both make-up and cooling system salinity at this facility are significantly lower than that achievable for DCPP. More importantly, the plant site is entirely dissimilar to DCPP. Hope Creek is situated on a flat and open location. The site is shared with the Salem Nuclear Facility in a 350 acre industrial security zone. Additional flat open area surrounds the industrialized security zone. The installed cooling tower at Hope Creek is also approximately 300-yards away from the operation unit, a configuration facilitated by the open space. The location has different atmospheric characteristics as well that support natural draft tower operations, and initial plant design also facilitates main condenser operations at significantly lower inlet pressures than that required for proposed closed-cycle functionality at DCPP. Additionally, emissions exhibited from natural draft towers are different than that for mechanical draft towers. Salt and other PM-10 emissions from Hope Creek's natural draft tower total approximately 372 lbs/day on average. This is in comparison to projected salt emissions of 4,800-19,800 lbs/day from a mechanical draft cooling tower installation at DCPP that would, by necessity, be immediately adjacent the operating units and associated 500KV transmission system.

In summary, both Palo Verde and Hope Creek were constructed to operate efficiently with the cooling systems installed as part of initial plant design. This includes condenser systems, associated rated system pressures, pumping equipment and configurations, and anticipated ambient water chemistry and atmospheric conditions. This is not comparable to a retrofit of a facility in a location with restricted open space, and that was initially designed and constructed for operation with the existing once-through-cooling system at current system pressures and performance. It is relevant to emphasis that steam electric power plants are essentially designed and constructed around a specific heat dissipation (heat-sink) system. Using comparisons to the conditions and performance of operating units sited, designed, and constructed with a specific cooling system as supporting evidence for determining the feasibility of retrofitting is fundamentally flawed

THE 1982 TERA REPORT SHOULD NOT BE A BASIS FOR A FINDING OF TECHNICAL FEASIBILITY

The Tetra Tech report inappropriately interpreted the statements and conclusions of the 1982 Tera Corporation report. Technical feasibility as defined in the Tera report was based on two specific criteria that did not include detailed evaluation of actual construction or implementation feasibility. The criteria included whether an alternative would reduce the heat and/or volume of the discharge and provide an additional practical, beneficial purpose. The Tera report specifically indicated that a retrofit would not be considered technically feasible if it required modifications to major plant components or systems such as the turbines, condensers or major plant structures. Subsequent evaluations have found that condenser modifications would be necessary. The Tera report also found that a retrofit of Diablo Canyon would be "beyond the proven state of the art." (Page 1-1).

Furthermore, the 1982 report was only intended to be a preliminary assessment, and did not account for all actual site installations, specifically the size and footprint of the existing underground seawater conduits west of the DCPP turbine building. The report was also published prior to commercial operation and actual operating experience for Unit-1 and Unit-2.

The diagrams provided in the Tera report (simple thin side by side lines denoting the intake conduits) are not representative of the installations in the area west of the turbine building. The main seawater conduits occupy a wide and extensive portion of the area underground. It is impractical that any substantial excavation, structure placement, or preliminary piping tie-ins be accomplished in this area without impacting operations of both units. Therefore, placement of a new pump house in this location presents many difficulties. Furthermore, the ocean bluff immediately adjacent presents further complexity to adequately support and seismically stabilize a structure that would house critical power production operating equipment.

SALT DEPOSITION IS A SERIOUS CONCERN AND RAISES SIGNIFICANT ENVIRONMENTAL AND PERMITTING ISSUES

On-site natural salt spray originates from wind interacting with the ocean 85-feet below the power plant ground level, and occurs on the opposite side of the turbine building from the 500KV transformer systems. Regardless of wind direction, current plant configuration protects the high voltage conductors and insulators from rapid and extensive salt contamination. Periods of excessive drift generated by high winds in combination with discharge outfall disturbance also remains west of the turbine building. Regardless, significant salt contamination and subsequent corrosion of the site administration, training, fabrication and warehousing support structures, and associated equipment, is currently extensive and negatively impacts ongoing site operation and maintenance costs.

The proposed cooling tower complex (as placed in the proposed configuration) would result in the emission of large volumes of salt at approximately the 140-foot elevation immediately adjacent the Unit-2 500KV transformers and transmission system connecting to the main switchyard. Site winds are in fact most frequently toward the Southeast, but winds, including gale force winds, do occur periodically to the North and Northeast. This condition recently occurred for 4-days straight (January 2008) due to gale force winds originating from the Southeast. The amount, elevation, and location of the salt drift from the tower complex would be far more damaging to the overall plant site, and present a new and direct threat to the 500KV systems currently shielded from routine ocean salt drift and deposition.

Simply increasing "washing" as suggested by Tetra Tech would not negate the introduced arcing and insulator flashover threat especially to the Unit-2 500KV system. During an unfavorable wind condition, the salt laden plume from the cooling towers would be driven directly into the high voltage transformer equipment and conductor lines.

Additionally, obtaining permitting for emissions from salt water mechanical draft installation would be extremely difficult and potentially unattainable. The region in which DCPP is located is in non-attainment for PM-10 emissions. Any new significant PM-10 emissions source is required to procure offsets which are not readily available. Additionally, Best Available Control Technology (BACT) is required for any emissions source greater than 25lb/day. Salt emissions from a DCPP retrofit to mechanical draft towers are estimated at 4,800-19,800 lbs/day. There is no reason to anticipate that any retrofit of the DCPP would be exempted from complying with San Luis Obispo County Air Pollution Control District (APCD) requirements. The APCD has previously commented on a similar proposed retrofit of the fossil fueled Morro Bay Power Plant to closed-cycle cooling. Reference the March 4, 2004 APCD letter to the State Regional Water Quality Control Board "Saltwater Cooling Towers Related to Air Quality – Duke Morro Bay Power Plant Modernization Project" 2006 Exhibit 7.

THE REMAINING DISCHARGE PRESENTS SERIOUS ENVIRONMENTAL AND PERMITTING CHALLENGES

Although permitting requirements remain uncertain, the Central Coast RWQCB has stated that any prolonged discharge with salinity more than 10% above ambient would require installation of a diffuser system, at a minimum, to be permitted (regardless of any other chemical contaminates). High salinity blow-down from the proposed cooling tower system is estimated to be approximately 72 mgd at a minimum. Therefore, even if remaining plant ASW/SCW once-through cooling volume of approximately 43 mgd could be used to dilute the tower blow-down, the combined discharge of approximately 115 mgd would remain >10% above ambient salinity, and a diffuser system would be required. This system would have to be placed on the ocean floor, and include piping that would extend out into the open sea significantly beyond the current discharge cove area. This installation itself would present a new and significant construction permitting challenge.

MINIMUM DOWN TIME WILL BE IN THE RANGE OF 12–18 MONTHS

PG&E's consultants believe that down time will be in the range of 12-18 months at a minimum. Tetra Tech does not provide any comparative information to assess whether estimates for plants such as Indian Point or Salem are relevant to a retrofit at Diablo Canyon. Specific site conditions and retrofit parameters are not presented that facilitate evaluation of the complexity of these proposed projects in comparison to that proposed for DCPP. Furthermore, it is known that the plant sites and surrounding areas at both these facilities are significantly more open and level than that at DCPP. Indian Point is located on a 239 acre site in an area of low rolling hills. Salem is located in conjunction with the Hope Creek Facility in a flat 350 acre industrialized security zone surrounded by additional flat open space. Indian Point has an available freshwater resource (Hudson River) and Salem a low salinity brackish water resource (Delaware River Estuary).

For the Salem Facility, Sargent & Lundy Engineering developed a conceptual retrofit assessment that estimates a 66-month overall site project which includes power production outages totaling at least 7-months (in addition to normal refueling outages) for each unit. However, the minimum outage estimates are based on conceptual designs only, and are not adequate for determining actual unit down-time required for successful implementation of a fully scoped retrofit. For the Indian Point Facility, Enercon Services similarly completed a retrofit assessment; however minimum unit outage estimates (in addition to normal refueling outages) were determined to be substantially more than the 4-months cited by Tetra-Tech.

At DCPP, extensive main condenser upgrades or retrofitting could not feasibly be accomplished in parallel with the extensive excavations and subsequent construction required for cooling water conduit modifications and tie-ins. These modifications must be accomplished underground in the only reasonable access pathway to the main condenser locations deep within the turbine building. Therefore, the bulk of these two general efforts would need to be performed in sequence in any realistic retrofit scenario resulting in extension of unit down time for this reason alone substantially above Tetra Tech estimates.

Even with prior site preparation and cooling tower unit construction, due to the certain extensive modifications required for the power plant seawater intake, main condenser upgrades, and the difficulty of tie-ins, PG&E remains certain that both units of DCPP would be inoperable for a minimum of 12-18 months even with favorable construction schedule adherence. Any discussion of retrofit feasibility must include realistic site specific construction time estimates, and not estimates based on generalities provided by industry equipment suppliers and vendors, or those based primarily on conceptual designs only.

THE DIABLO INTAKE IS DESIGNED TO MINIMIZE IMPINGEMENT

The DCPP intake structure was designed using operational experience from PG&E's former Sacramento Delta power plants, and civil engineering guidance that incorporated information from "Studies on Fish Preservation at the Contra Costa Steam Plant of the Pacific Gas and Electric Company" 1953, authored by James Kerr (State of California Department of Fish and Game, Fish Bulletin No. 92). Fish impingement related operational experience, and findings of the Kerr study, were integrated into the PG&E 1960 Civil Engineering Manual for Circulation Water Systems. The manual identifies "Protection of Fish" recommendations for intake design that include engineering low intake structure approach water velocities and lateral escape routes for fish.

These engineering recommendations were used during design of the DCPP intake. Specific impingement reduction consideration incorporated into the DCPP intake structure include a wide and flat (straight) opening that generates a uniform low velocity water flow from the mouth of structure up to the cooling water pump bay closure gates, installation of cut-outs between closure gate forebays, and installation of a passive fish return bay on each end of the structure. Large 5-ft. x 27.9-ft. (139.5 square-foot) cut-outs were placed in concrete forebay partitions to provide a route for water and fish to freely migrate across the structure behind the debris exclusion bar racks, and an additional bar rack bay was constructed at each end of the structure with a 9-ft. wide racked opening. Together, these characteristics provide a lateral escape route designed into the structure. The extra end bays provide a location for fish to move out of the intake flow and migration back out of the intake structure. In combination with placement of the intake in an engineered cove (designed to protect the intake structure from severe ocean swell damage) impingement losses experienced during DCPP operations have been very low demonstrating effectiveness of the implemented design criteria to limit fish impingement